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Studies in lichen and lichenicolous fungi: more notes on taxa from North America

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Abstract — The following taxa are reported for the first time from North America: *Arthonia diploiciae, Opegrapha dolomitica, Reconditella physconiarum, Sarcogyne sphaerospora,* and *Thalloloma anguiniforme*.

1. ***Arthonia diploiciae*** Calat. & Diederich, Mycotaxon 55: 366. 1995.

Type: Spain, Almeria, Campo de Dalias, Punta del Sabinal, 10 m, on *Diploicia canescens* on *Juniperus phoenicea*, 16.iii.1993, *E. Barreno et al. s.n.* (VAB–lich. 7547, holotype; IMI–362752, isotype).

Arthonia diploiciae is a lichenicolous fungus on the thallus of *Diploicia canescens* (Dicks.) A. Massal., arising in groups of up to 125 ascomata, 70–130 µm each in diameter, and inducing conspicuous brown spots on the thallus of the host. The asci are 4-spored and the ascospores 1-septate, with the lower cell slightly attenuated, apices rounded, 15–22 × 7–12 µm (see illustration and full description in Calatayud et al. 1995). The species was described from Spain and Portugal and has been reported from the Canary Islands and Mexico (Hafellner 1995), Great Britain (Hawksworth 2003) and Ireland (Santesson 1998). *Arthonia diploiciae* is frequent on *D. canescens* on the stems of *Coreopsis gigantea* (Kellogg) H.M. Hall, on East and West Anacapa Islands in the Channel Islands National Park in Ventura County, California. The species is currently included on the North American Checklist (Esslinger 2008) as occurring in North America north of Mexico on the basis of "North America" having been cited in the "World Distribution" section of the entry for this species in the treatment of Sonoran *Arthonia* species by Grube (2008). The species has

previously been known in North America only from Baja California, Mexico and our reports verify it as occurring in North America north of Mexico.

Specimens examined. — **U.S.A. California. Ventura Co.:** East Anacapa Island, Channel Islands National Park, between the lighthouse and NPS housing on slopes above and below trail, 55 m, 34°00'56"N 119°21'43"W, on *Diploicia canescens* on *Coreopsis gigantea*, 30.xi.2008, *K. Knudsen 10753* (UCR); north side, 52 m, 34°00'54"N 119°22'04"W, on *Diploicia canescens* on *Coreopsis gigantea*, 3.xii.2008, *K. Knudsen 10912.2* (UCR); West Anacapa Island, Channel Islands National Park, slope above Rat Rock, 34°00'48"N 119°26'32"W, 28 m, on *Diploicia canescens* on *Coreopsis gigantea*, 19.xi.2008, *J. Kocourková & K. Knudsen* (PRM 915316).

2. ***Opegrapha dolomitica*** (Arnold) Clauzade & Cl. Roux ex Torrente & Egea, Bibl. Lichenol. 32: 146. 1989.

Opegrapha rupestris var. *dolomitica* Arnold, Flora 43: 78. 1860.

Type: [Germany], "An einer Dolomitwand im Laubwalde des Ankathales zwischen Hersbruck und Velden", viii.1859, *F.C.G. Arnold s.n.* [= *? Lich. Exs. 104*] (L, lectotype; NY!, isolectotype?).

Opegrapha gyrocarpa var. *dolomitica* (Arnold) Körb., Parerg. Lich. p. 251. 1865.

"Opegrapha dolomitica" (Arnold) Clauzade & Cl. Roux, Bull Soc. Bot. Centre-Ouest, nouv. sér., num. spec. 7: 827. 1985, nom. inval.

During the recent Tuckerman Workshop (September, 2008) on the Bruce Peninsula of Ontario, Canada, the author and his colleagues had the opportunity to visit calcareous habitats along the shoreline of Georgian Bay of Lake Huron. At one locality we collected several specimens of an *Opegrapha* species growing on calcareous rock ledges and cool humid overhangs. Study of this material revealed that it represented *Opegrapha dolomitica* a rare European species of calcareous rocks (Torrente & Egea 1989). Several collections made by the first author while surveying limestone barrens on the Great Northern Peninsula of the Island of Newfoundland, Canada, also represent *O. dolomitica*. *Opegrapha dolomitica* can be identified by its occurrence on calcareous rocks, esorediate thallus, absence of secondary lichen substances (C–, K–, P–, UV–), 3-septate ascospores ((20–)22–26(–31) × 5–8 µm fide Clauzade & Roux 1985), irregularly shaped ascomata (+/– circular to elongate short lirellae) with epruinose discs, an I+ persistently red hymeniun and K– epihymenium. These are first reports of *O. dolomitica* from North America. Further populations are likely to be found on calcareous shoreline rocks in boreal/sub-arctic regions of North America.

While preparing the discussion for this paper we reviewed the correct authority for the combination using the name *O. rupestris* var. *dolomitica* at the species level. The combination *O. dolomitica* was not validly published by Clauzade & Roux (1985) because they cited the wrong basionym and place of publication ("*O. gyrocarpa* v. *dolomitica* Körb., Parerg. Lich., 251. 1861"). Unfortunately this cannot be treated as a bibliographic error to be corrected because Körber (1865 [not 1861]) included a direct reference to the correct

basionym and place of publication ("Syn. *Opegrapha rupestris* β *dolomitica* Arnold in Flora 1860 p.78"). Thus the place of valid publication is Torrente & Egea (1989) not Clauzade & Roux (1985).

Specimens examined. — **CANADA. Newfoundland & Labrador:** Island of Newfoundland, Watts Point Ecological Preserve, 20.vii.2006, *J.C. Lendemer 8830* (NY), 17.viii.2007, *J.C. Lendemer 17056 & A. Moroz* (NY, distributed as *Opegrapha* sp. *in Lich. East. N. Amer. Exs. VI: 293*). **Ontario. Bruce Co.:** Bruce Peninsula National Park, Halfway Log Dump on Georgian Bay, 19.ix.2008, *J.C. Lendemer 14154–A* (NY), *J.C. Lendemer 14156–A* (NY), *J.C. Lendemer 14174* (NY).

3. ***Reconditella physconiarum*** Matzer & Hafellner, Bibl. Lichenol. 37: 47. 1990.

Type: Austria, Steiermark, Gesäuse-Gebiet, John´s brook, ca. 0.5 km E of tavern Köbl, ca 875 m, MTB 8453/4, on *Fraxinus excelsior*, on *Physconia distorta*, 20.v.1988, *J. Hafellner 20271 & E. Schreiner* (GZU, holotype; hb, Hafellner, hb. Matzer, isotypes).

Reconditella Matzer & Hafellner is a monospecific genus in the *Sordariales* (Matzer & Hafellner 1990). *Reconditella physconiarum* is characterized with brownish-black perithecioid ascomata sitting in the lower part of the lobe edges, without developed basal subiculum, 220–400 µm wide, 200–500 µm high, with periphyses and unbranched or infrequently branched interascal filaments, 8-spored asci functionally unitunicate and ascospores non-septate to occasionally with 1 septum above median level (rarely median), ellipsoid or in the lower part narrower, at first hyaline and halonate, becoming in maturity light brown and slightly verrucose, (13–)15–17.7–21(–24) × (6–)8–10(–13) µm. It is considered a parasymbiont. It is known on *Physconia distorta* (With.) J.R. Laundon, *P. muscigena* (Ach.) Poelt, and *P. venusta* (Ach.) Poelt and it is reported from Austria, Croatia, Portugal and Sweden (Matzer & Hafellner 1990) as well as from Spain (Etayo & Diederich 1998), Russia (Zhurbenko 2004), and Germany (Kocourková & Brackel 2005).

The ascomata in North American specimen of *Reconditella physconiarum* are about 300 µm in diam. and are in the lower range of size compared to ascomata in European specimens on *Physconia*. They differ from European specimens in the ascomata usually penetrating the thallus from the lower side. Only occasionally do ascomata develop at the edges of lobes as in European specimens. Moreover, it seems our specimen is parasitic rather than parasymbiotic: the host thallus is suppressed in size and slightly bleached where the infection is most developed. In some parts, the host thallus is infected with another lichenicolous fungus, *Syzygospora physciacearum* Diederich. Here we report *R. physconiarum* as new to North America from southern California on the new host *Physconia isidiigera* (Zahlbr.) Essl.

Specimen examined. — **U.S.A. California. Riverside Co.:** Santa Ana Mountains, Santa Rosa Plateau, near Tenaja Road, 626 m, 33°29'59"N 117°21'17"W, on *Physconia isidiigera,* on *Quercus agrifolia*, 11.iv.2007, *J. Kocourková & K. Knudsen* (PRM 915343).

4. ***Sarcogyne sphaerospora*** J. Steiner, Österr. Bot. Zeitschr. 49: 251. 1899.

Type: Armenia, Caucasus Mountains (holotype not located).

During recent collecting trips in the mountains of southern California above 5000 feet, we discovered a lichenicolous taxon of the *Acarosporaceae* with a carbonized exciple and epihymenium, having spherical ascospores 4–5 µm in diameter with a distinct perispore or mucilage layer, parasitic on *Candelariella rosulans* (Müll. Arg.) Zahlbr. The taxon was not conspecific with any species of lichenicolous *Polysporina* Vězda that we recently studied (Knudsen & Kocourková 2008). Instead it appears to be *Sarcogyne sphaerospora*, described as a parasite on *Candelariella vitellina* (Ehrh.) Müll. Arg. from the Caucasus Mountains of Armenia. The holotype was supposed to be deposited at W but was not located (pers. comm., O. Breuss). Until we can locate the type and further specimens we include our specimen in the concept of *S. sphaerospora* and report it new to North America (Esslinger 2008). Though the species definitely fits in the current concept of the genus *Polysporina* (Vězda 1978) we refrain from transferring the species from *Sarcogyne* Flot. until we have completed a revision. We hope this report may bring to our attention more specimens for study. We do not expect *S. sphaerospora* at this time to be restricted to members of the genus *Candelariella* Müll. Arg. because none of the other lichenicolous species of *Polysporina* we have recently treated is host specific.

We doubt the validity of *Polysporina* as a natural genus. Our study of the genus has found that the only character distinguishing the genus from the core group of *Sarcogyne* is a carbonized epihymenium (Knudsen 2008a; Knudsen & Kocourková 2008). We agree with Claude Roux (pers. comm.) that a carbonized epihymenium does not appear to be a robust systematic character to distinguish a genus, though it is useful as a taxonomic character for distinguishing species in *Acarosporaceae*. Recent unpublished molecular results from sequencing *Polysporina* specimens by Valerie Reeb (pers. comm.) and Martin Westberg (pers. comm.), although not conclusive, suggest that a carbonized exciple and epihymenium and a lichenicolous habit may have arisen several times in the phylogeny of the *Acarosporaceae*. If this is true, we speculate if *Sarcogyne sphaerospora*, is related to two *Acarospora* species that have spherical ascospores with a distinct perispore or mucilage layer, and that are lichenicolous parasites when juvenile, but which develop independent lichenized thalli with non-carbonized aspicilioid apothecia when mature: *A. stapfiana* (Müll. Arg.) Hue and *A. succedens* H. Magn. (Knudsen 2008b).

Specimen examined. — **U.S.A. California. San Bernardino Co.:** San Bernardino Mountains, San Bernardino National Forest, FS 2N93 off CA 38, Moonridge Quad., 7462 ft., 34°10'29"N 116°47'11"W, conifer/oak woodland with granite outcrops, on *Candelariella rosulans* on granite, 7.x.2008, *J.C. Lendemer 14917–A & K. Knudsen* (NY).

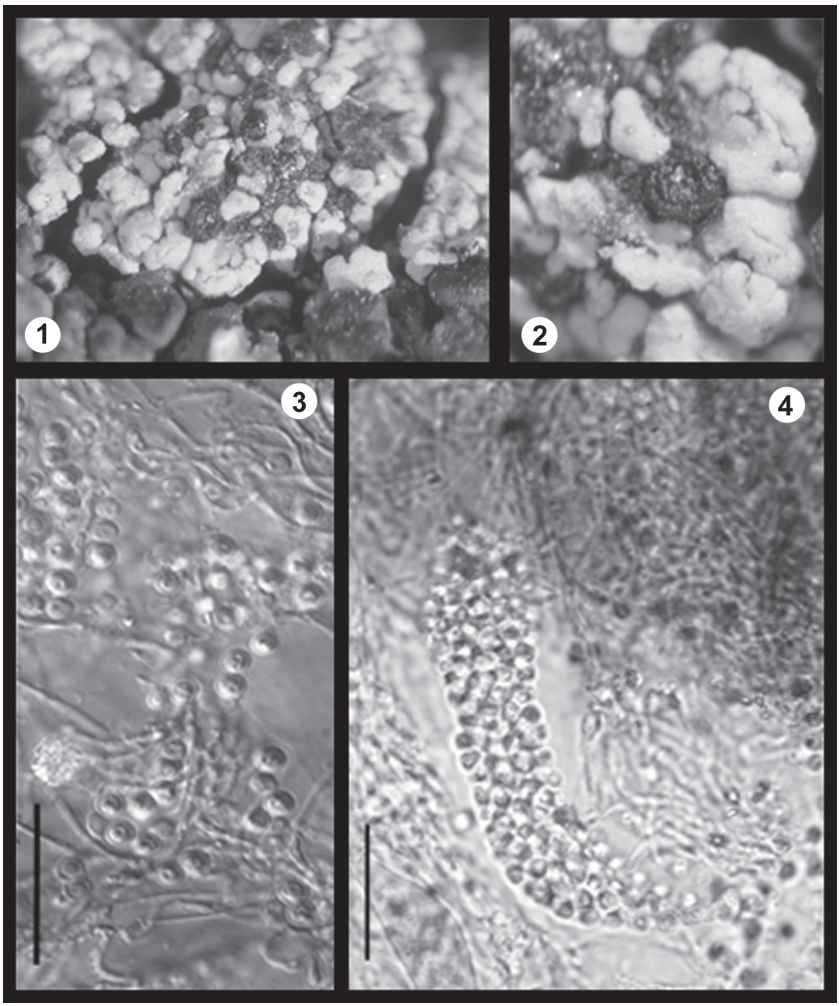

Plate 1. ***Sarcogyne sphaerospora*** (Lendemer 14917-A, NY). Figure 1, gross morphology of infection (x 10). Figure 2, detail of apothecium (x 20). Figure 3, ascospores and paraphyses (scale bar = 20µm). Figure 4, intact ascus with ascospores (scale bar = 20µm).

5. *Thalloloma anguiniforme* (Vain.) Staiger, Bibl. Lichenol. 85: 427. 2002, as "*anguinaeforme*".

Graphis anguiniformis Vain., Acta Soc. Fauna Fl. Fenn. 7(2): 110. 1890, as "*anguinaeformis*". Type: Brazil, Minas Gerais, ad corticem arboris in Carassa, 1400 m., 1885, *E.A. Vainio s.n.* = *Lich. Bras. Exs. 274* (TUR, holotype; M, isotype).

Graphina anguiniformis (Vain.) Zahlbr., Cat. Lich. Univ. 2: 398. 1923, as "*anguinaeformis*".

Recently we began the task of updating the North American species of *Graphidaceae* (in the traditional sense not including the *Thelotremataceae*) to follow the modern generic concepts proposed by Staiger (2002). In conjunction with this reorganization we have also attempted to resolve the status of the taxa that have been recognized but not formally named (e.g., Harris 1990, 1995) as well as identify undetermined material that has accumulated at various herbaria. This work has yielded the discovery of another subtropical species in Florida that has not previously been reported from North America, *Thalloloma anguiniforme*.

Species of *Thalloloma* Trevis. can be recognized by a lack of carbonization in the exciple, hyaline ascospores, non-warty paraphysis tips that are brown and granular, the absence of periphysoids, and non-fissurine apothecia with exposed discs. Among species of *Thalloloma,* the species reported here can be recognized by its unpigmented discs and large muriform ascospores (55–95 × 25–30 µm fide Staiger (2002)). The chemistry of *T. anguiniforme* was not given by Staiger (2002) because of the only specimen available at that time was too small for analysis. The specimen reported here contains lichexanthone (K–, C–, KC–, P–, UV+ yellow).

Specimen examined. — **U.S.A. Florida. Dixie Co.:** Steinhatchee Wildlife Management Area, along Andrew Sauls Rd., ca. 0.4 mi N of Co. Rd. 351 just N of Scrub Creek Baptist Church, ca. 6 mi NE of Cross City, oak scrub and oak woods, on *Quercus*, 4.xii.1993, *R.C. Harris 31618–A* (NY).

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Literature cited

Arnold F. 1860. Die Lichenen des Fränkischen Jura. Flora 43: 66–80.

Calatayud V, Atienza V, Barreno E. 1995. Lichenicolous fungi from the Iberian Peninsula and the Canary Islands. Mycotaxon 55: 363–382.

Clauzade G, Roux C. 1985. Likenoj de Okcidenta Europo. Ilustrita Determinlibro. Bulletin de la Societe Botanique du Centre-Ouest, Nouvelle Série, Numero Special 7. Royan, France. 893 pp.

Esslinger TL. 2008. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. North Dakota State University: http://www.ndsu.nodak.edu/instruct/esslinge/chcklst/chcklst7.htm (First Posted 1 December 1997, Most Recent Version (#14) 8 October 2008), Fargo, North Dakota.

Etayo J, Diederich P. 1998. Lichenicolous fungi from the western Pyrenees, France and Spain. IV. Ascomycetes. Lichenologist 30(2): 103–120.

Grube M. 2008 ("2007"). *Arthonia* In: TH Nash III, C Gries, F Bungartz (eds.): Lichen Flora of the Greater Sonoran Region, Vol. 3. Lichens Unlimited, Arizona State University, Tempe, Arizona, pp. 39–61.

Hafellner J. 1995. Bemerkenswerte Funde von Flechten und lichenicolen Pilzen auf makaronesischen Inseln II. Einige bisher übersehene arthoniale Arten [Noteworthy records of lichens and lichenicolous fungi from Macaronesian islands. II. Some previously overlooked arthonialean species]. Herzogia 11: 133–142.

Harris RC. 1990. Some Florida Lichens. Publ. by the Author, Bronx, N.Y. 109 pp.

Harris RC. 1995. More Florida Lichens. Including the 10¢ Tour of the Pyrenolichens. Publ. by the Author, Bronx, N.Y. 192 pp.

Hawksworth DL. 2003. The lichenicolous fungi of Great Britain and Ireland: an overview and annotated checklist. The Lichenologist 35(3): 191–232.

Knudsen K. 2008a ("2007"). *Polysporina*. In: TH Nash III, C Gries, F Bungartz (eds.): Lichen Flora of the Greater Sonoran Region, Vol. 3. Lichens Unlimited, Arizona State University, Tempe, Arizona, pp. 276–278.

Knudsen K. 2008b ("2007"). *Acarospora* In: TH Nash III, C Gries, F Bungartz (eds.): Lichen Flora of the Greater Sonoran Region, Vol. 3. Lichens Unlimited, Arizona State University, Tempe, Arizona, pp. 1–38.

Knudsen K, Kocourková, J. 2008. A study of lichenicolous species of *Polysporina* (*Acarosporaceae*). Mycotaxon 105: 149–164.

Kocourková J, von Brackel W. 2005. Einige fur Bayern neue Flechtenbewohnende Pilz. Beitrag zu einer Checkliste I. Berichte der Bayerischen Botanischen Gesellschaft 75: 3–10.

Körber GW. 1865. Parerga Lichenologica. Breslau, 501pp.

Matzer M, Hafellner J. 1990. Eine Revision der lichenicolen Arten der Sammelgattung *Rosellinia* (*Ascomycetes*). Bibliotheca Lichenologica 37: 1–138.

Santesson R. 1998. Fungi lichenicoli exsiccati, Fasc. 11 & 12 (nos. 251–300). Thunbergia 28: 1–19.

Staiger B. 2002. Die Flechtenfamilie *Graphidaceae*. Studien in Richtung einer natürlicheren Gliederung. Bibliotheca Lichenologica 85: 1–526.

Torrente P, Egea JM. 1989. La Familia *Opegraphaceae* en el Area Mediterranea de la Peninsula Iberica y Norte de Africa. Bibliotheca Lichenologica 32: 1–282.

Vězda A. 1978. Neue oder wenig bekannte Flechten in der Tschechoslowakei. II. Folia Geobotanica et Phytotaxonomica 13: 397–420.

Zhurbenko MK. 2004. Lichenicolous and some interesting lichenized fungi from the northern Ural, Komi Republic of Russia. Herzogia 17: 77–86.